

THE HISTORY OF THE

BY

W. G. M. M. A.

IMPROVED CREOSOTE OIL

BY

P. C. REILLY



Specifications

FOR

The Reilly Improved Creosote Oil



COMPLIMENTS OF

REPUBLIC CREOSOTING COMPANY

INDIANAPOLIS, INDIANA

The Reilly Improved Creosote Oil

Extracts from a paper read before the Convention of the American Wood Preservers' Association held in New Orleans, Louisiana, January 20-22, 1914, by
Mr. P. C. Reilly, President of the Republic
Creosoting Company

The term "Creosote Oil" should be a specific term, denoting a material obtained from a specific source. As applied to wood-preserving material its use should be restricted to distillates obtained from coal tar. It should not be applied to the distillates obtained from petroleum tar, nor should it be applied to a mixture of creosote oil with tar, petroleum, asphalt, resin or other substances.

Originally, and until quite recently, the term was accepted as exclusively describing a coal tar distillate, but the adulteration of creosote oil within the last decade, and more especially within the last six or seven years, has brought about

An Abuse of the Term

and has removed from it the definiteness it originally possessed—a definiteness which should again be restored to it.

In mixing creosote oil with tars, petroleum, resin, asphalts or other substances, the resultant material is an article quite different from the coal tar distillate. The petroleum distillates, because they do not in any way closely approximate the coal tar distillate, should be listed under some distinguishing name and, similarly, the mixtures above referred to, or any other mixtures,

Should Also Be Listed Under Specific Titles.

Neither petroleum distillates nor any other mixture should appropriate the name creosote oil, and neither should they be sold nor used as such.

The wood preserving industry is growing so rapidly, the results now expected so exacting, and creosote oil so important a factor in

the success of the industry, that it is essential from the scientific view point—as well as that of the buyer and seller—that creosote oil should be indicative of one specific material and, within a reasonable range,

Indicative of the Quality of that Material.

If 20 lbs., 16 lbs., or 12 lbs. of oil to the cubic foot are used for the preservation of lumber, it is assumed that the amount specified is sufficient for the purpose, that is, sufficient to get the full mechanical wear of the lumber in its original strength. If the lumber immediately after treatment and before use shows the full treatment, but after exposure for a few years it shows a considerable less quantity, due to volatilization, it is deficient, and failure will follow.

The report of Prof. Alleman in Government Forestry Circular No. 98 contains some very instructive information on the portion of creosote oil that is permanent for wood preservation. He says: "The average distillate up to 270 degrees C. of the creosote oil extracted from thirty-seven samples of timber, thirty-six of which were

In Use From Nine to Twenty-four Years,

and one for forty-three years, was 32.91 per cent.; high-boiling oils, 66.79 per cent."

The timber was preserved, not because of the volatile oil in the original injection—it had gone; evaporated or washed out, or both—but because with the light oil there happened to have been a sufficient portion of stable, fixed oil, which remained. The oil, too, is shown to have had much more of the high-boiling oil and valuable constituents than are now customarily obtained.

The lack of basic high-boiling oils in most of the commercial creosote oils is well known, and I have sometimes thought that the need of these heavier basic oils being felt by creosoters,

Explains the Adulteration of Creosote Oil

with tar and other viscous substances, and that these adulterations are used on the mistaken theory that they supply the known deficiencies of creosote oils such as are commonly produced. Such mixtures, however, instead of supplying the need and improving the oil, affect its quality adversely.

721 2089-68 OT

A stable creosote oil can be (and is) produced from coal tar, and this oil is practically indestructible and unchangeable. It will penetrate timber at low pressure and at low heat.

The Tar Is Ready to Give Up This Stable Creosote Oil

if the distiller seeks to get it.

The four essential features desired in an oil used for wood preservation are penetrability, stability, preservativeness and waterproofness.

PENETRATION—The depth to which an oil will penetrate a porous body depends upon the physical properties of the oil as well as the size and construction of the cavities in that body. The oil must be in a liquid state and of such consistency that the particles will move freely upon one another if the

Best Results of Penetration Are Expected.

If an oil is composed of a mixture of several materials which differ widely in the mobility of their particles the penetration of the more limpid materials will be decreased by the amount of resistance im-

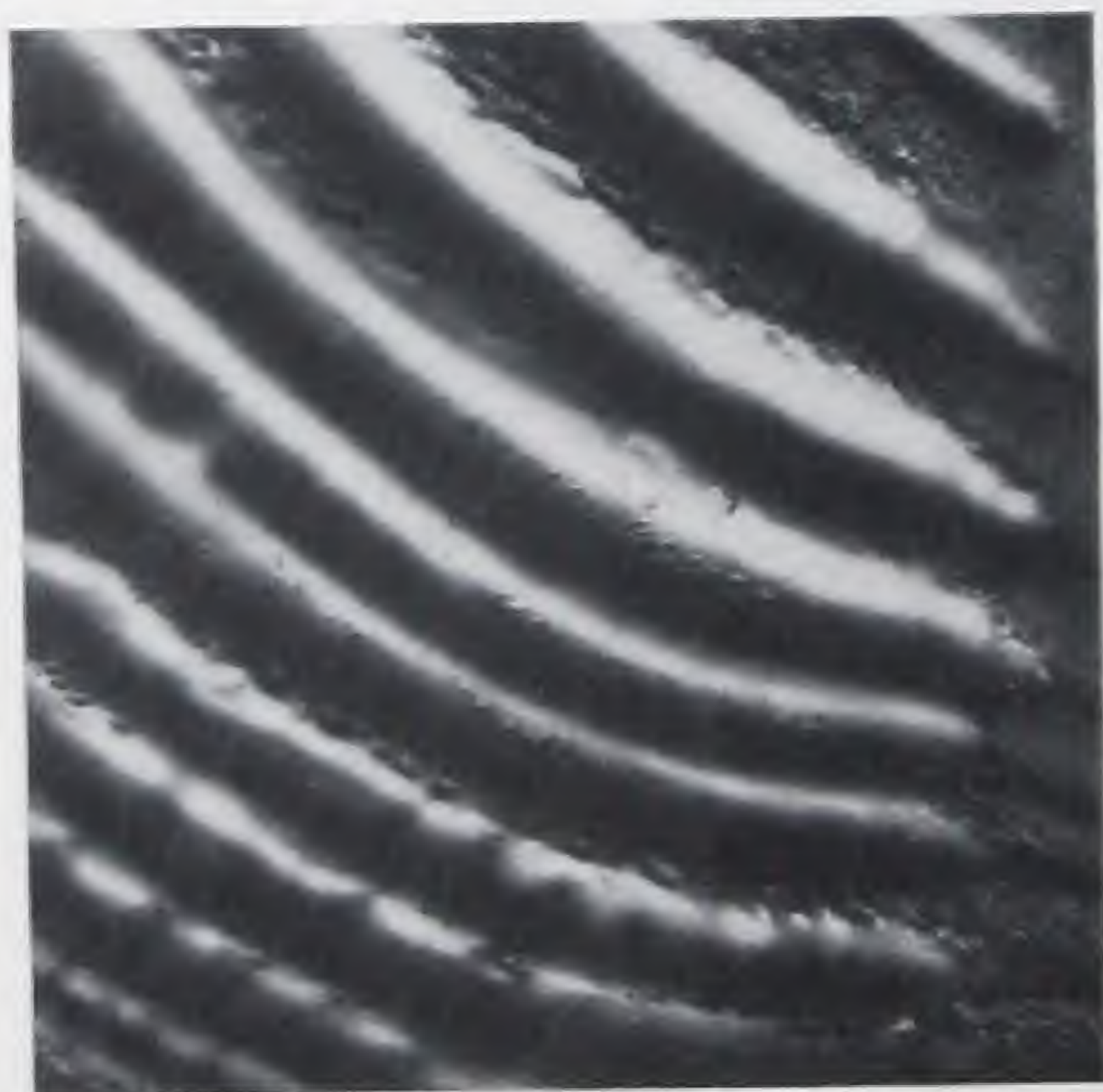


Fig. A



Fig. B

posed by the more viscous matter. Creosote oil has a high penetration coefficient, while tar has a low one. The degree of penetration also depends upon the temperature of the liquid. The higher the temperature (within certain limits) the freer the liquid will flow and more

easily will it enter the pores of the solid material which it penetrates.

When such material as wood is penetrated some kinds offer little resistance, while

Others Offer Much Resistance.

This depends on the size of the pores, the smoothness of the cell walls and the extent of material obstructions contained in the cells. The spring growth of any wood offers less resistance to the penetration of an oil than the summer growth, for the reason that the cells of the spring growth are larger than those of the summer growth. The variation in the size of these cells in the same kind of wood is very great, so that it is reasonable to believe that an impregnating medium composed of both limpid and viscous matter (and some solid substances in suspension)

Would Be Subject to Separation

of the viscous materials into two or more constituents. If the medium were composed of creosote oil and tar (the tar containing free carbon) the separation would show oil, tar and carbon.



Fig. C



Fig. D

It can be demonstrated that while such an impregnating mixture will enter the more porous portion of the fiber, there is a point reached where the cell openings are so fine that they prevent the more viscous matter from entering the pores, and it follows that at the time of this

separation the more viscous matter is retained on the surface of the fiber. (Figures A and B illustrate this.)

It has been claimed that "tar oil" (a mixture of tar and creosote oil) can be raised to such a temperature that the viscosity will equal that of creosote oil when heated to the proper degree of temperature for practical use in creosoting and as the viscosity of the mixture is the same as the creosote oil, the penetration likewise will be equal. This

Contention is Incorrect

and can be easily proven so. To demonstrate the inaccuracy of the claim that fluids of like viscosity possess like degrees of penetrability it will be sufficient to take three (3) parts of creosote oil (specific gravity 1.05 at 60 degrees F.) and one (1) part tar (specific gravity 1.123 at 100 degrees F. carbon 6 per cent.), mix them together and bring the mixture to such a temperature that the viscosity will indicate a sufficient limpid liquid for good penetration

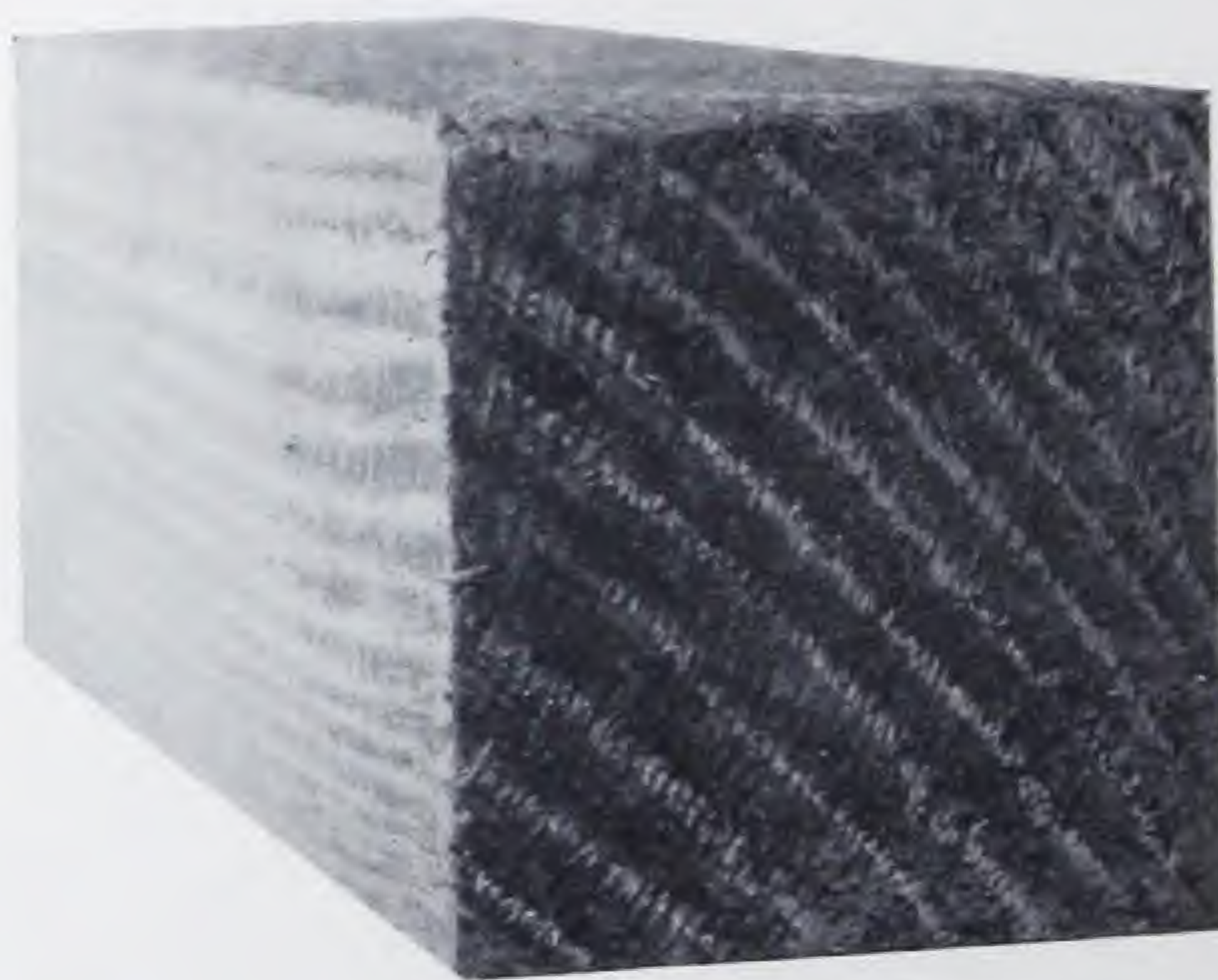


Fig. E

when such a mixture is used in the ordinary process for treating timber. The final result will show clearly that a separation of the mixture does take place (at either high or low temperature) and that the more viscous substances of the mixture are deposited on the surface of the treated material when the grain is close as in long leaf yellow pine. (Figs. C and D illustrate this.)

When the treating fluid is of such a nature as to contain no viscous

material, as tar or pitch, the liquids of various gravities when heated to a temperature usually required in treating timber penetrate freely and

There Is No Difficulty Experienced

in the way of separation of the oils. The oil as a whole enters the fibres—no sticky mass is deposited on the surface of the timber. (Fig. E. illustrates this.)

STABILITY—The stability of a preservative oil depends on both its chemical and physical properties. If the substance as a whole contain certain portions that are very volatile and on exposure much of the material is lost or, if it is of a light specific gravity and

Is Exposed to Moisture and to Rain,

as in the case of most treated timber, much of the oily and water-soluble portion of the preservative will leach out from the wood and leave the fibre unprotected. Figure F shows loss of the preservative by volatilization.



Fig. F

The "heavy creosote oil," on account of its high specific gravity, high-boiling point, slight solubility in water and the strong chemical union of the compounds composing this material, render it very stable and

Durable Under All Conditions

required of a wood preservative. The insolubility in water and the high specific gravity prevent its removal by such forces as rain or

tides. Its high boiling point renders it but slightly volatile in the strongest heat of the sun. In all properties of the "heavy creosote oil" nothing but stability of the highest degree is found. Figs. E and G show stability of the "heavy oil" as against the unstability of light oil.



Fig. G. (See also Fig. F)

PRESERVATIVE—An ideal means of preservation is in the use of a stable oil which contains an antiseptic poisonous constituent and also possesses the

Property of Adhering to the Cell Walls

and fibres of the wood with such permanency as to prevent conditions that are favorable to the development and existence of elements destructive of timber. By such a preservative all organisms are killed at the time of treatment, and the fibre of the timber is surrounded by a coating of oil in such a way as to prevent the attack of any organism. When these two qualities (antiseptic and stable oil) are combined in one material we have one of the best mediums that science can produce for wood preservation.

WATERPROOFING—This can be accomplished by coating the cell walls with a heavy creosote oil which will leave a waterproof film so firmly adhering to the walls of all the cavities that moisture is excluded from the cells.

If the cell walls are coated with a permanent film impervious to moisture there can be

No Swelling of the Paving Blocks,

ties, or timber so treated, as the water will be excluded from the cells, without the presence of which no swelling can take place. If there is no swelling from moisture there is no subsequent contraction from dryness. The physical condition of the timber therefore remains practically, if indeed not absolutely, unchanged.

It does not matter if water enters the pores of the wood if the fibres are so thoroughly protected that they

Cannot Absorb Water.

If the fibres cannot absorb water, they cannot expand. If the fibres do not expand, the timbers cannot expand.

It is useless to inject something into timber to preserve it if it is known that it will leave the timber by evaporation, leaching or otherwise. It follows that if there is volatilization of the preserving material there is just so much space left for the admission of water and other destructive elements.

In wood preservation we have two commodities to deal with. One is timber, nature's product, which in itself cannot be changed, and the other creosote oil, man's production,

Which Can Be Controlled

and which he must bring up to the necessary quality to get greatest efficiency. If a creosote oil were adopted of such quality that the original injection into the timber remained in the timber—the lumber being sufficiently treated—the preservation of the timber would be permanent.

DISCUSSION.

Following the reading of Mr. Reilly's paper the following discussion took place:

MR. P. E. FREDENDOLL: In regard to the waterproofing, as you were speaking of it there, do you consider that it will be possible

to waterproof a timber without thoroughly penetrating it throughout? For instance, a twelve by twelve timber, do you mean to say that you think it is possible to get a creosote oil of such a character that you can waterproof that stick so that it won't expand or contract?

MR. P. C. REILLY: No; not unless the fibre is coated with the oil.

MR. P. E. FREDENDOLL: The entire fibre of the timber?

MR. P. C. REILLY: Yes.

MR. C. M. TAYLOR: In other words, how much would you treat a tie to avoid expanding and contracting?

MR. P. C. REILLY: Well, I think eighteen pounds to the cubic foot will obtain that result.

MR. C. M. TAYLOR: That is fine.

MR. H. L. COLLIER: We are very much troubled in some of the large cities with the bleeding of the blocks. May I ask Mr. Reilly if the oil he recommends will give us relief from this serious objection so frequently emphasized by our competitors? If we specify a pure distillate oil should we, under the terms of our specifications, get pure creosote oil or will the manufacturer have a legal or moral right to compound the same with tar?

MR. P. C. REILLY: I should think not, if the oil specified was to be a pure distillate oil. It would be necessary to comply with the specifications.

DR. H. VON SCHRENK: * * * I unfortunately came in late and did not hear all that the last speaker said, but I gained the impression, as I frequently have occasion to do, that a good deal of the discussion concerning coal tar and creosote oil, is based on a type of investigation which frequently does not give up the data we are looking for. The question of the addition of coal tar to creosote oil is largely a commercial consideration. *Personally I always have felt that it would be a good thing for the creosoting industry if we never had any coal tar and IF WE HAD NOTHING BUT THE TYPE OF HIGH GRADE OILS WHICH I SHOULD JUDGE THE*

LAST SPEAKER (Mr. Reilly) referred to. If any one can tell me where I can buy high grade oils I would like to know where I can do it.

* * * * *

MR. R. J. CALDER: May I ask a purely commercial question? If you could get an oil approximately conforming to No. 1 oil (Maintenance of Way specifications) is it more advisable to use that for general treatment, including paving blocks, than to use the mixture?

DR. H. VON SCHRENK: *I certainly would prefer the best creosote every time.*

COMMENTS.

In the foregoing paper Mr. Reilly has logically proved and graphically portrayed that the "bleeding" of treated timber, especially in the form of street paving blocks, is directly due to adulteration of the preservative. This adulteration (tar principally) has been the general practice of creosoters during the past six or seven years, before which time

A "Bleeding" Block Was Practically Unknown.

On the contrary, it is now a condition that may be looked for and confidently expected if the present practice of adulteration is kept up. During the hot season of each year loud protests are heard on all sides against the tar which oozes from wood paving blocks and settles on the surface in a sticky, disagreeable mass.

To make the streets passable it becomes necessary to cover them with

Layers of Sand to Absorb the Tar.

This mixture of tar and sand is scraped up and hauled away, and the street immediately is re-covered with a second layer of sand to absorb the next exudation of tar which inevitably follows. This process must be repeated during every recurrent hot period and until tar no longer remains in the block. The tar having been drawn out, the blocks are left unwaterproof and absorb moisture, swell and "buckle."

The cost of spreading sand over the seas of tar and hauling the mixture away is

No Inconsiderable Item of Expense.

With sand delivered on the street, say at \$1.00 a cubic yard, a one-half inch layer, without the expense of spreading it, would be practically a cent and a half per square yard. The cost of scraping up and hauling away the mixture would be at least three times greater than cost of the sand, or four and one-half cents a square yard. To this should be added the cost of the sand, making

A Total Cost of Six Cents Per Square Yard

to take care of a condition that has no legitimate right to exist. This process repeated two or three times a season imposes a very heavy penalty on taxpayers, to which must be added the thousands of dollars lost in ruined rugs, carpets and tile and wearing apparel due to the tar being tracked from the street and carried into stores, hotels and homes on the feet of pedestrians.

The adoption of a specification that will demand a creosote oil that will meet in every particular the requirements of the specifications for The Reilly Improved Creosote Oil will make a "bleeding," swelling, or buckling wood block street a thing of the past. This character of creosote oil

Will Eliminate a Civic Nuisance

and provide a wood block pavement that will not only be ultimate economy, but will also provide a street that always will be clean, durable, handsome and sanitary.

The Reilly Improved Creosote Oil

Specifications

THE OIL.

Section 1. The oil shall be a distillate obtained wholly from Coal Tar.

Sec. 2. It is required by these specifications that the oil used shall be wholly a distillate oil, obtained only by distillation from coal tar. No other material of any kind shall be mixed with it. When two or three drops of the oil are placed on white filter paper and viewed by transmitted light, the oil-spot must be of a golden-amber color.

Sec. 3. The oil at no time shall contain more than one (1) per cent of matter insoluble in hot benzol and chloroform. Should the insoluble matter exceed one (1) per cent, the oil shall be rejected.

Sec. 4. Its specific gravity at thirty-eight (38) C. shall not be less than one and ten-hundredths (1.10) and not more than one and fourteen-hundredths (1.14).

DISTILLATION.

Sec. 5. The oil shall be subjected to a distilling test as follows:

(a) The apparatus for distilling the creosote must consist of a stoppered glass retort having a capacity, as nearly as can be obtained, of eight (8) ounces up to the bend of the neck, when the bottom of the retort and the mouth of the off-take are in the same plane. The bulb of the thermometer shall be placed one-half ($\frac{1}{2}$) inch above the liquid in the retort at the beginning of the distillation, and this position must be maintained throughout the operation. A condensing tube shall be attached to the retort by a tight cork joint. The distance between the thermometer and the end of the condensing tube shall be twenty-two (22) inches, and during the process of the distillation the tube may be heated to prevent the congealing of the distillation. The upper third of the retort and at least two (2) inches of the neck must be covered with a shield of heavy asbestos paper during the entire process of distillation, so as to prevent heat radiation, and there must be placed between the bottom of the retort and the flame of the lamp or burner two (2) sheets of wire gauze, each twenty (20) mesh fine and at least six (6) inches square. The flame must be protected against air currents.

(b) The distillation shall be continuous and uniform, the heat being applied gradually. It shall be at a rate approximating one (1) drop per second, and shall take from thirty (30) to forty (40) minutes after the first drop of distillate passes into the receiving vessel. The distillates shall be collected in weighed bottles and all percentages determined by weight in comparison with the dry oil. When one hundred (100) grams of the oil are placed in the retort and subjected to the above test, the amount of the distillate shall be as follows:

Up to 200 degrees Centigrade, not more than 1 per cent.

Up to 250 degrees Centigrade, not less than 8 per cent.

Up to 315 degrees Centigrade, not less than 25 nor more than 35 per cent (25-35).

Up to 380 degrees Centigrade, not more than 70 per cent.

(c) The residue above 380 degrees C. shall have a specific gravity not less than 1.17 nor more than 1.21 at 25 degrees C., and, when cooled to twenty (20) degrees Centigrade, shall not be hard or brittle, but shall be soft and of a wax-like nature, so that it can be readily indented with the finger. When a small portion of this residue is placed on white filter paper and warmed, the oil spot produced, when viewed by transmitted light, shall appear of an amber or reddish-brown color. If the spot is black the oil shall be rejected.

TAR ACIDS.

Sec. 6. The tar acids in the total distillate to 315 degrees C. shall not be less than three (3) per cent of the volume of this distillate.

Method of Determination of Tar Acids.

(a) Place 10 cc. of the distillate (to 315 degrees C.) in a beaker; add fifteen (15) cc. of a 15% caustic soda solution; heat the mixture to 100 degrees C. for thirty minutes, stirring the liquid frequently; then pour it into a small separatory funnel and allow it to stand until the alkaline solution and oil have separated. Draw off the alkaline liquid into a Babcock milk bottle and return the oil to the beaker. Treat this oil as before, using only 10 cc. of caustic soda. After allowing the two liquids to separate add this alkaline solution to the other in the milk bottle. Now add to the combined alkaline solutions in the milk bottle

sufficient dilute sulfuric acid to make the liquid in the bottle decidedly acid, and if necessary add enough more acid to bring the liquid into the neck of the bottle. Place the bottle in a Babcock machine and centrifuge it for 5 minutes, at the speed used for testing milk, then read off and calculate the per cent of acid in the distillate.

(b) (If a Babcock machine is not accessible the process can be carried out by pouring the two portions of alkaline liquid into a 50 cc. burette; add sufficient acid to cause the tar acids to separate and set the burette aside for 3 hours, after which read off the amount of tar acids and calculate the percentage.)

SAPONIFICATION.

Sec. 7. The unsaponified oil in the distillate from 250 degrees C. to 315 degrees C. shall not exceed two (2) per cent of the volume of this distillate, nor shall the fraction of the distillate from 315 to 380 degrees C. contain more than 2 per cent of unsaponifiable oil.

Method for Saponification Test.

(a) Pour the measured portion, ten cubic centimeters (10 cc.), of oil into a Babcock's milk bottle and add twice the amount of concentrated sulfuric acid (1.84).

(b) After shaking the bottle until the oil and acid are thoroughly mixed, place the bottle in a water bath and keep it at a temperature of boiling water for one hour. At frequent intervals (say every ten minutes) shake the bottle vigorously, so as to keep the contents well mixed during the time of heating. At the end of the hour add enough concentrated sulfuric acid to bring the liquid into the neck of the bottle.

(c) Place the bottle in a Babcock machine and centrifuge it for fifteen minutes, at the usual speed for estimating butter fat. Read off the amount of unsulfonated oil. If this amount is in excess of two per cent (2%) of the distillate (250 degrees to 315 degrees C.), then draw off the unsulfonated oil into another milk bottle and treat it with a 10% caustic soda solution, heating and estimating the amount of unsaponifiable oil in the same manner as described above, using only caustic soda throughout this latter process.

(d) The unsaponifiable oil remaining after this treatment **must** not exceed two per cent (2%) of the fraction of the distillate from 250 degrees to 315 degrees C.

[In the absence of a Babcock machine the process can be carried out in a beaker. The contents of the beaker, after being heated as described above, can be poured into a 50 cc burette and after standing for 12 hours the amount of unsaponified oil read and the per centage calculated. If the result of this calculation shows more than 2% of unsaponified oil treat this unsaponified oil with 10% caustic soda as described above.]

THE RESIDUE.

Sec. 8. The residue above 380 degrees Centigrade.

(a) The total residue above 380 degrees when cooled to twenty degrees Centigrade (20 degrees C) shall not be hard or brittle, but shall be soft and of a wax-like nature, so that it can be readily indented with the finger. When a small portion of this residue is placed on white filter paper and warmed, the oil-spot produced, when viewed by transmitted light, shall appear of an amber or reddish brown color. If the spot is black the oil shall be rejected.

(b) The specific gravity of this residue (above 380 degrees C.) shall be not less than 1.17 nor more than 1.21 at 25 degrees C.

(c) The specific gravity of the distillate from 400 to 420 degrees C shall be at least 1.12 at 38 degrees C.

(d) If the total residue above 380 degrees C. is soft but not of a crystalline nature, the distillation shall be carried to 420 degrees C., and the distillate from 400 degrees C. to 420 degrees C., tested for unsaponifiable oils, and if more than one per cent (1%) of this fraction is unsaponifiable, ~~and~~ ^{the} oil shall be rejected.

The method of saponification must be carried out as described in Section 7.

[Note: It is impossible to prescribe in brief space a sufficient number of positive tests to accurately determine the presence and nature of every adulterant. If, therefore, a chemist or an engineer is not satisfied that the requirements of these specifications have been met and that the oil is adulterated he should apply tests in addition to those set forth in these specifications to determine the nature of the possible adulterant.]

